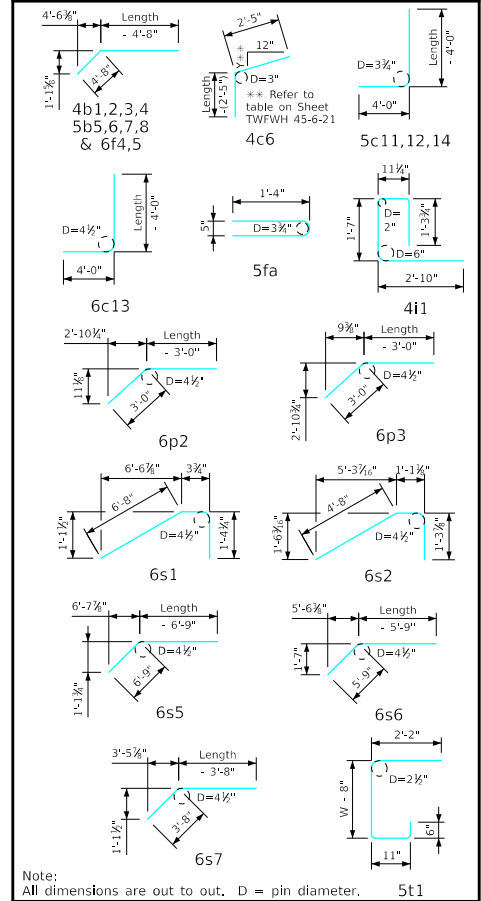


ENGLISHLRFDDESIGNEDTWINCULVERTSWH.DGN - TWFH 45-7-21 51 - THIS SHEET ISSUED 02-2021.

Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height

Bar	Location	Shape	12' x 12'			12' x 11'			12' x 10'			12' x 9'			12' x 8'			Bar								
			No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.	No.	Length	Wt.									
5fa	Fence Anchor (Galv.)		2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	2	2'-10"	6	5fa								
4b1	Wingwall, B.F.H. Long		1	76'-3"	53	1	70'-6"	49	1	64'-8"	45	1	58'-10"	41	1	53'-0"	37	4b1								
4b2	Wingwall, B.F.H. Short		1	47'-6"	33	1	44'-0"	31	1	40'-7"	29	1	37'-1"	25	1	33'-7"	22	4b2								
4b3	Wingwall, B.F.H. Long		10	Var. 21'-2 to 73'-6	326	9	Var. 21'-2 to 67'-8	275	8	Var. 21'-2 to 61'-11	228	7	Var. 21'-2 to 56'-1	185	6	Var. 21'-2 to 50'-3	146	4b3								
4b4	Wingwall, B.F.H. Short		10	Var. 14'-6 to 45'-11	205	9	Var. 14'-6 to 42'-5	173	8	Var. 14'-6 to 38'-11	143	7	Var. 14'-6 to 35'-5	117	6	Var. 14'-6 to 31'-11	93	4b4								
5b5	Wingwall, F.F.H. Long		1	76'-4"	82	1	70'-6"	76	1	64'-8"	70	1	58'-10"	64	1	53'-0"	58	5b5								
5b6	Wingwall, F.F.H. Short		1	47'-7"	52	1	44'-1"	48	1	40'-7"	45	1	37'-1"	39	1	33'-7"	35	5b6								
5b7	Wingwall, F.F.H. Long		11	Var. 15'-5 to 73'-7	526	10	Var. 15'-5 to 67'-9	446	9	Var. 15'-5 to 61'-11	373	8	Var. 15'-5 to 56'-1	306	7	Var. 15'-4 to 50'-3	244	5b7								
5b8	Wingwall, F.F.H. Short		11	Var. 11'-1 to 46'-0	333	10	Var. 11'-1 to 42'-6	282	9	Var. 11'-1 to 39'-0	235	8	Var. 11'-1 to 35'-6	194	7	Var. 11'-1 to 32'-0	157	5b8								
5b9	Interior Wall, Both F.H.		21	Var. 6'-11 to 37'-9	489	19	Var. 6'-11 to 34'-11	415	17	Var. 6'-11 to 32'-2	346	15	Var. 6'-11 to 29'-4	284	13	Var. 7'-0 to 26'-6	227	5b9								
4c1	Wingwall, F.F.V. Long		72	Var. 2'-9 to 15'-0	427	66	Var. 2'-9 to 13'-11	367	60	Var. 2'-9 to 12'-11	314	54	Var. 2'-9 to 11'-11	265	49	Var. 2'-9 to 11'-0	225	4c1								
4c2	Wingwall, F.F.V. Short		43	Var. 2'-10 to 14'-10	254	40	Var. 2'-10 to 14'-0	225	36	Var. 2'-10 to 12'-10	188	33	Var. 2'-10 to 12'-0	163	29	Var. 2'-10 to 10'-10	132	4c2								
4c3	Wingwall, F.F.V. Long		33	Var. 9'-7 to 15'-1	272	27	Var. 9'-7 to 14'-0	213	21	Var. 9'-7 to 13'-0	158	15	Var. 9'-7 to 12'-0	108	--	--	--	4c3								
4c4	Wingwall, F.F.V. Short		20	Var. 9'-7 to 15'-0	164	17	Var. 9'-7 to 14'-1	134	13	Var. 9'-7 to 13'-0	98	10	Var. 9'-7 to 12'-1	72	--	--	--	4c4								
4c5	Wingwall, F.F.V. Long		1	13'-9"	9	2	12'-9"	17	2	11'-9"	16	2	10'-9"	14	1	9'-9"	7	4c5								
4c6	Wingwall, F.F.V. Short		2	13'-9"	18	1	12'-9"	9	2	11'-9"	16	1	10'-9"	7	2	9'-9"	13	4c6								
4c7	Interior Wall, Both F.V.		2	4'-1"	5	2	4'-1"	5	2	4'-1"	5	2	4'-1"	5	2	4'-1"	5	4c7								
4c8	Interior Wall, Both F.V.		66	Var. 1'-10 to 12'-5	314	61	Var. 1'-10 to 11'-6	272	55	Var. 1'-10 to 10'-5	225	50	Var. 1'-10 to 9'-6	189	44	Var. 1'-10 to 8'-6	152	4c8								
5c9	Wingwall, B.F.V. Long		15	Var. 2'-9 to 5'-2	62	15	Var. 2'-9 to 5'-2	62	15	Var. 2'-9 to 5'-2	62	15	Var. 2'-9 to 5'-2	62	15	Var. 2'-9 to 5'-2	62	5c9								
5c10	Wingwall, B.F.V. Short		4	Var. 2'-10 to 3'-8	14	4	Var. 2'-10 to 3'-8	14	4	Var. 2'-10 to 3'-8	14	4	Var. 2'-10 to 3'-8	14	4	Var. 2'-10 to 3'-8	14	5c10								
5c11	Wingwall, B.F.V. Long		57	Var. 9'-4 to 19'-0	842	51	Var. 9'-4 to 17'-11	725	45	Var. 9'-4 to 16'-11	616	39	Var. 9'-4 to 15'-11	514	34	Var. 9'-4 to 15'-0	431	5c11								
5c12	Wingwall, B.F.V. Short		39	Var. 8'-0 to 18'-10	546	36	Var. 8'-0 to 18'-0	488	32	Var. 8'-0 to 16'-10	414	29	Var. 8'-0 to 16'-0	363	25	Var. 8'-0 to 14'-10	298	5c12								
6c13	Wingwall, B.F.V. Long		47	10'-6"	741	41	10'-6"	647	35	10'-6"	552	29	10'-6"	457	24	10'-6"	379	6c13								
6c13	Wingwall, B.F.V. Short		28	10'-6"	442	25	10'-6"	394	21	10'-6"	331	18	10'-6"	284	14	10'-6"	221	6c13								
5c14	Wingwall, B.F.V. Long		1	17'-9"	19	2	16'-9"	35	2	15'-9"	33	2	14'-9"	31	1	13'-9"	14	5c14								
5c14	Wingwall, B.F.V. Short		2	17'-9"	37	1	16'-9"	17	2	15'-9"	33	1	14'-9"	15	2	13'-9"	29	5c14								
4d1	Apron, Longit., Bott.		17	38'-6"	437	17	35'-8"	405	17	32'-10"	373	17	30'-0"	341	17	27'-2"	309	4d1								
4d2	Apron, Longit., Bott. Long		3	68'-10"	143	3	63'-0"	131	3	57'-2"	119	3	51'-5"	108	3	45'-7"	96	4d2								
4d3	Apron, Longit., Bott. Short		3	42'-7"	90	3	39'-1"	78	3	35'-7"	71	3	32'-1"	64	3	28'-7"	57	4d3								
6f1	Apron, Longit., Top		24	38'-6"	1388	24	35'-8"	1266	24	32'-10"	1184	24	30'-0"	1081	24	27'-2"	979	6f1								
6f2	Apron, Longit., Top Long		15	Var. 6'-7 to 34'-10	467	14	Var. 5'-8 to 32'-0	396	12	Var. 6'-11 to 29'-2	325	11	Var. 6'-1 to 26'-4	268	9	Var. 7'-3 to 23'-6	208	6f2								
6f3	Apron, Longit., Top Short		9	Var. 8'-1 to 35'-2	292	8	Var. 8'-8 to 32'-4	246	8	Var. 5'-9 to 29'-6	212	7	Var. 6'-4 to 26'-8	173	6	Var. 6'-10 to 23'-10	138	6f3								
6f4	Apron, Longit., Top Long		1	76'-4"	118	1	70'-6"	110	1	64'-8"	101	1	58'-10"	92	1	53'-0"	83	6f4								
6f5	Apron, Longit., Top Short		1	47'-7"	75	1	44'-1"	70	1	40'-7"	65	1	37'-1"	56	1	33'-7"	50	6f5								
4f1	Parapet, Vertical		51	6'-8"	227	49	6'-8"	218	49	6'-8"	218	49	6'-8"	218	49	6'-8"	218	4f1								
7j1	Parapet, Horizontal		4	37'-8"	308	4	37'-4"	305	4	37'-0"	303	4	37'-0"	303	4	37'-0"	303	7j1								
6m1	Apron, Trans., Top		19	Var. 30'-0 to 33'-5	905	18	Var. 29'-9 to 32'-11	847	18	Var. 29'-6 to 32'-8	840	18	Var. 29'-6 to 32'-8	840	17	Var. 29'-6 to 32'-6	792	6m1								
6m2	Apron, Trans., Top		13	Var. 33'-9 to 38'-3	703	10	Var. 33'-2 to 36'-6	523	7	Var. 32'-11 to 35'-2	358	3	Var. 32'-11 to 33'-8	150	1	Var. 24'-11 to 24'-11	37	6m2								
6m3	Apron, Trans., Top		33	Var. 9'-11 to 27'-11	938	33	Var. 9'-3 to 27'-3	905	32	Var. 8'-6 to 25'-11	827	32	Var. 7'-11 to 25'-5	801	31	Var. 7'-4 to 24'-3	735	6m3								
6m4	Apron, Trans., Bott.		24	Var. 28'-11 to 53'-5	1531	22	Var. 28'-10 to 51'-2	1362	20	Var. 28'-8 to 48'-11	1198	18	Var. 28'-8 to 46'-10	1046	16	Var. 28'-8 to 44'-8	899	6m4								
6p1	Curtain, Horizontal		4	35'-4"	212	4	35'-2"	211	4	35'-1"	211	4	35'-1"	211	4	35'-1"	211	6p1								
6p2	Curtain, Horizontal, Long		4	42'-4"	269	4	39'-2"	235	4	36'-0"	216	4	32'-10"	197	4	29'-8"	178	6p2								
6p3	Curtain, Horizontal, Short		4	15'-8"	94	4	14'-7"	88	4	13'-7"	82	4	12'-7"	76	4	11'-7"	70	6p3								
6s1	Wing Slope, Both F., Long		2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	2	8'-4"	25	6s1								
6s2	Wing Slope, Both F., Short		2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	2	7'-11"	24	6s2								
6s3	Wing Slope, Both F., Long		2	68'-7"	213	2	62'-8"	196	2	56'-9"	178	2	50'-10"	160	2	44'-11"	142	6s3								
6s4	Wing Slope, Both F., Short		2	41'-8"	132	2	38'-0"	114	2	34'-5"	103	2	30'-9"	92	2	27'-1"	81	6s4								
6s5	Wing Slope, F.F. Long		1	74'-8"	116	1	68'-9"	107	1	62'-10"	98	1	56'-11"	89	1	51'-0"	80	6s5								
6s6	Wing Slope, F.F. Short		1	47'-8"	75	1	44'-0"	70	1	40'-4"	64	1	36'-9"	55	1	33'-1"	50	6s6								
6s7	Interior Wall, Both F.H.		2	39'-1"	117	2	36'-2"	109	2	33'-3"	100	2	30'-3"	91	2	27'-3"	82	6s7								
5t1	Curtain, Vertical		61	7'-11"	504	58	7'-8"	464	55	7'-5"	425	52	7'-2"	389	48	6'-11"	346	5t1								
Estimated Quantities			Reinf. Steel			15,699 LB			3,9			13,973 LB			3,8			10,793 LB			9217 LB					
One Headwall			Concrete			138.1 CY			33.1			118.5 CY			25.4			100.8 CY			21.1			87.8 CY		
			Parapet Δ			4.0			3.9			3.8			3.8			3.8			3.8			3.8		
			Wingwalls			42.1			33.1			25.4			21.1			17.2			17.2			17.2		
			Apron *			92.0			81.5			71.6			62.9			54.6			54.6			54.6		

Bent Bar Details



Δ Includes top of wingwall quantities.
 * Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.
 Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall
 "Long" Denotes Long Wingwall

Headwall Notes:

- See Sheet TWFH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE	APPROVED BY BRIDGE ENGINEER	 Standard Design - Twin Reinforced Concrete Box Culverts <h2 style="margin: 0;">Flared Wing Headwalls</h2> February, 2021 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">Quantity Tabulation 12'-0" Span 45° Skew</td> <td style="width: 50%; text-align: center;">TWFH 45-7-2</td></tr></table>	Quantity Tabulation 12'-0" Span 45° Skew	TWFH 45-7-2
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